Kiran Thirumaran: Hello, everyone. Thank you for joining the webinar today. We are going to give folks another moment to log in. We will be starting soon.

Let's get started. Hello, everyone, and welcome to the 2022-'23 Better Buildings Webinar Series dedicated to bringing you the latest actionable insights from leading industrial experts. The annual series is a chance to explore the topics, technologies, and trends that affect your organization as well as efforts to accelerate decarbonization and energy efficiency adoption.

So, today's webinar—next slide, please. Yeah. So, today's webinar is called, "It's Electric! Electrified Alternatives to Industrial Fossil Fuel Systems." Before we dive in, there are a few housekeeping points I would like to cover. Please note, today's webinar will be recorded and archived in the Better Buildings Solution Center. We will follow up with the recordings after today's session.

Next, attendees are in listen only mode. So, your microphones are muted. If you experience any audio or visual issues throughout the webinar, please send a message in the Q&A box at the bottom of your Zoom panel. Next slide.

My name is Kiran, and I'm your moderator today. I'm research staff at Oak Ridge National Lab, and I help run the Better Plants Program for the Department of Energy. I work as a Technical Account Manager a part of the program, and I work with close to 15 manufacturing partners, helping them on their energy efficiency and decarbonization journey. Next slide.

So, today's webinar, we have three really good speakers from the manufacturing sectors who are going to be talking about their electrification journey. Before we get into the speakers, we have a few polls, and I also have a few introduction slides to give you an overview and set the stage for the conversation today. Next slide. Next slide, please. Yeah.

So, electrification in industries, in the manufacturing sector. So, electrification fundamentally is a switch from non-electric fuel fired systems to electric systems, right? And within our facilities, the opportunity to change our fossil fuel systems to electric is there in a couple of areas. Process heating is a big one, especially in the manufacturing sector. So, process heating meaning, cleans the furnaces that you use for your drying operations to smelt, and to cure products, right? So, there's a lot of opportunities in the process heating side. There's also opportunities on the HVAC side

of things. Again, this is applicable to manufacturing sectors and to other commercial buildings and facilities, as well. A lot of the traditional HVAC systems are fuel fired, either fired by natural gas and sometimes even in propane. So, that's an opportunity to change those out to electric. Again, there's various different opportunities there with heat pumps, with electric heaters, electric boilers, et cetera. And also, with fleet vehicles, there is a huge potential for electrification, right? The fleet vehicles that you own as part, in your organization, or in the forklifts that you use in your warehouses.

So, the chart to the right—next one, next slide. Yeah. So, the chart to the right is a footprint of the total energy used by the manufacturing sector in the U.S. What you'll see here, the total manufacturing sector uses, like, 14 quads. So, one quad is the 10^{15} BTUs. So, the total manufacturing sector uses around 14 to 15 quads, out of which, almost like 7.5 quads is used for this process heating, right? So, process heating accounts for almost, like, 50 percent of the total energy used in the manufacturing sector, and also, the building HVAC uses around like 1 quad of the total energy.

An interesting point to note here is, of the 7 quads that we spoke about for process heating, only 5 percent of that is being served by electricity. The rest of it is fuel fired and, like, steam systems. And similarly, on the facility HVAC side, only like 25 percent to 26 percent is being served with electricity. So, the bottom line here is, there is a lot of opportunity for electrification in these systems that exist in the manufacturing sector. Next slide.

And the next slide pretty much gives you a little bit, gives more context to the same point, right? The chart to the left breaks down, by each industry, how much of the energy is used for process heating, and how much of that is electricity, right? So, the bar is on the yellow, which is just a sliver of the total process heating energy that represents the electricity. And, of course, you see, it varies quite a bit with industries, right? Some of the industries, there is a little bit of energy being used from electricity for these process heating applications, like in the iron and steel sector, where they have, like, electric arc furnaces that are quite a developed technology, they do use quite a bit. But still, there is a lot of opportunities to kind of, like, push that low bar further down to encompass the gray one, which is the total energy being used. Next slide.

So, why do we want to do this, right? We see that there is a lot of potential for electrification in the manufacturing sector and in other sectors, a well. So, why do we want to do it? Obviously, we are looking at it from the lens of emissions and energy improvements, but electrification and electrotechnologies have benefits that go beyond, right?

So, there is cool benefits that come with these technologies that go beyond just the energy and emissions reduction. And our speakers will be going, will be talking more about this, they'll be talking about the benefits that they have been able to achieve in their facilities, and this goes with improved productivity, improved product quality. Electrification gives you much more flexibility in the way you do things, so, there is a lot of flexibility in your operation, and in some cases, it could even give you better safety profiles and reduced maintenance cost, right? And for all these various different reasons, we do see a lot of electrotechnologies that are coming up.

We see we have a lot of promising electro technologies in various different sectors. We spoke about arc furnaces in the iron and steel, and in the metal smelting side. We have, like, microwave and radio frequency that has a really high uptake in the food and beverage sectors, and obviously, there is cross-cutting technologies like forklifts, like heat pumps, that are applicable for HVAC applications. Not just on the manufacturing side, but also on the commercial and residential side of things, as well. Alright, so, next slide.

So, today, we'll be using an interactive platform for questions and answers and polling. Please go to Slido.com on your mobile device, or on your laptop. So, in the chat box, you'll see a link to it, and you'll be able to ask our panelists questions using the Slido link. Please submit them any time during the presentation. We'll be answering your questions near the end of the webinar. Also, you can, like, vote up, you can select the thumbs up icon for any of the questions that you like, which will result in the most popular questions moving to the top of the queue.

So, we wanna learn more about you. So, let's start off with a couple of polls. Please join us over at Slido to respond to the following questions. If you have any issues, please message our tech support on Zoom, as well.

So, the first question we have is—what sector best describes your organization? So, we wanna know which sector you're from, so

you can choose from the different options that are available—industry, state government, local government, higher education, consultant. Alright, let's give a moment for the answers to stabilize a little bit.

Alright, I think we can display the results. Awesome.

So, we have a lot of people from the industry sector, a lot of consultants and contractors, as well, and we also have a good group of people coming from, like, state and local governments and other non-government organizations. Perfect. Alright.

So, let's move to the next question we have. So, the next question we have is, what are the electrification opportunities most relevant to your facilities, right? So, again, this is, from your perspective, what do you think are the most relevant opportunities for electrification at your facilities? So, you can choose from electrification of your forklifts and fleet vehicles, implementation of heat pumps, and implementation of other electric HVAC systems like resistive heating for air or water. Electrification of steam production if you think that is an opportunity, if you are using a lot of steam and you think there is an opportunity to electrify that. And also, electrification of process heating systems. Again, these are the cleans and furnaces that we spoke about that uses a lot of fuel fire, fossil fuel that could be changed to electric options.

Alright, so, yeah, take a moment to think about it and choose what you think is most appropriate. Alright, so, we have almost an overwhelming response, at least right now, for heat pumps. Again, like, heat pumps are a major electrification technology that is coming up, and a few of our speakers are gonna be talking about heat pump applications in their facility as well. And the heat pumps for HVAC, and even heat pumps for heat recovery options, right, within the manufacturing sector. So, heat pumps is a very cross-cutting technology that could be applicable across the board.

Alright, let's show the results. Awesome. Alright, yeah, thank you, everyone, for responding those. That's really helpful feedback for us. Yeah, so, let's go back to our presentation.

So, today, we have a great lineup of presenters today. So, we have Gordon Smith from Ingersoll Rand, Antony Oaks from DENSO Corporation, and Nickyle Milton joining us from Siemens.

So, the first presenter is gonna be Gordon Smith. Gordon is the Director of Operations Sustainability for Ingersoll Rand Corporation. Gordon has over 30 years of experience in the manufacturing sector, ranging from automotive, appliances, and industry products. His past responsibilities include manufacturing and maintenance engineering management, new equipment and plant launches at both local and corporate level. He has worked for Chrysler, Ford, and Daimler Chrysler, as well. For 10 years prior to joining Ingersoll Rand, he was the Global Director for Sustainability and Maintenance for Electrolux AB. Gordon holds an undergraduate degree in electrical engineering from Queens University at Kingston, Canada, and a Master's degree in alternative energy technologies from Wayne State at Michigan.

With that, I'll pass it—hand it over to Gordon to kick us off.

Gordon Smith: Thank you, Kiran. So, I'm really happy to have this opportunity to show you guys what we've been working on; more specifically, what all the teams across manufacturing have been working and focusing on with regards to operations, sustainability, and specifically, how that ties to our greenhouse gas reduction KPIs and what we have said that we would do by 2030 and 2050. And then, how does electrification, how does that play into our strategy? How is that part of so far what we're doing and what we need to do? Next slide. We can just go to the next one, please.

So, who are we? So, we are, you probably know us for compressors, or you may know us for blowers or any type of other fluid system. So, you've got air and gas compressors and vacuum pumps, positive displacement pumps, liquid handling. So, we can compress just about any gas, and we do. And also, various pumps around just whatever industry you can think of, we sell into. So, you probably, if you don't know us through the Ingersoll Rand name, you may know one of the other many, many brands that we have for these products.

So, this is our roadmap for greenhouse gases. So, the goal that we have as a company, the commitment that we've made is that by 2030, we'll have a 60 percent reduction in absolute greenhouse gases to the 2020 base year, right? So, everything in between 2030 and 2020 is the, "How are we gonna get there?"

So, first off, you always need to be focusing on energy efficiency. So, before you electrify, before you start making other things, you should have a good, solid energy efficiency program in place that should be there as you're starting to electrify, as you're doing other

things, and honestly, it should always be there. Because your manufacturing environment is always changing, and efficiency and continuous improvement really need to be part of this if you're going to stay on top of the changing environment that comes with it, right?

So, within here, you'll see a lot of energy efficiency, whether it's through our own internal Green Excellence program that is cross-functional teams at the site level with the skills to be able to do energy and water management and add renewable energy as it comes, through LED lighting and smart sensors. On here, you'll see some electrification. So, right now, on our current roadmap, there's only certain things we need to do in order to hit the 2030 goal. Now, if we were looking at 2050, where we've got net zero as our goal in scope 1 and 2, it's going to have to include all forms of electrification, right? But for 60 percent, our current roadmap only requires that we be working on electrification in fork trucks. Our hybrid—you know, our service vehicles and our company vehicles need to switch to hybrid, and then they need to switch to electric.

And another good point is, as you start to electrify these things, it means you're gonna need to buy more electricity, right? So, it means you need to buy, in some way, renewable electricity. And we're doing that typically in one of three ways. We are either purchasing renewable electricity from utility such that we get the certificate, you know, the environmental attribute comes to us, or we're doing on-site solar, either—you know, we're doing it either with, mostly, we're doing it with our own resources right now for on-site solar, or before the meter type projects. And then also, we have some, we're currently looking at some plans for virtual power purchase agreements for much larger blocks of renewable electricity that's coming from, not necessarily on our site, but off of the same grid that our sites are drawing from.

So, all of those things are part of our roadmap, and I think we can go to the next slide.

Yeah, so, let's talk about internal transportation, fork trucks from propane to electric. Here, we hope to have pretty much all of this converted in the next two years. We've been making some—our teams have been making some really great progress. Some of these pictures are of our GreenX Teams within the sites, proudly displaying their electric fork trucks.

So, I mean, there's lots of good reasons to do this, not the least of which is zero emissions inside the building, right? You don't have any of that combustion exhaust. There also are some safety concerns that can come from the changing of the propane tanks that disappears when you go electric. They're much quieter, they have much less vibration, they're easier to drive, they require less maintenance. So, you know, this is one of those win/win/wins that you look for when you're trying to do transitions.

The other thing I would say, it may be not just fork trucks, but it could be lifts that you stand on. But also, if you look at the bottom, you'll see what is guided vehicles, you know, sophisticated guided vehicles or automatic guided vehicles that either are automatic or driven. These are easily electrified. These can become part of your strategy to move away from fork trucks altogether and go to a train type distribution system that feeds assembly lines.

One of the big concerns that comes up is, you know, we need battery stations and charging stations. Those have not turned out to be a big deal. You know, we've put them in. I wouldn't say there's really been any real concerns that have come out of it. Often, you get down to, "Well, the only thing I have left is some very large fork trucks, and I don't use them very often." So, you just, you need to think about this. Because if you have a very low use for a very large fork truck, it may or may not make sense to do the conversion. But it's not about whether electric can do the job, because it can, all the way up to as large as 40,000 pounds. And you can see on the right, you can see the picture, that's actually a big steel fork truck in Germany, the biggest one that I've seen so far, and I think they make them even bigger.

So, certainly, this is a good pathway to do, whether you own your own or if you've got leases. As your lease comes up, you can arrange to convert, right? But yeah, so, that's—next slide, please.

Then, on our roadmap, we've got service vehicles. So, for us, as an example on the right, we've got some very large installations when it comes to compression technology. These can be very remotely located, that need to be installed and serviced. So, the requirement here is, we need to carry quite a payload, and we need to go long distances, and of course, reliable, right? So, in terms of easy transitions, you know, Ford and GM and others are coming up with the larger full-sized trucks that are hybrids or fully electric. We now have 120 hybrids that we've put into our fleet. So, this is a big focus area for us. They need to be quick charge. We need to have some way for technicians to be able to maybe even charge them at

home, so, we have that logistics that we're working through, but we're on our way to converting the fleet over to first hybrid and then electric, very much dependent on what's available and when we can get it with all the supply chain issues going on, that seem to be turning around now, so. Next slide.

So, one of the things that's not on the roadmap, but it's growing, and for sure, it'll become part of our 2030 roadmap, specifically coming out of the work that we're doing in Europe, where they have a lot of building heat. And I would say the majority of our natural gas, by far, is coming from building heat. We have process heat, but nothing compared to our building heat. And it's the same here in the U.S. So, typically, it's either top right where you've got natural gas, radiant heating, distributed, there's combustion happening right at the burner, if you would. Or it could be a forced air combustion on the left that hangs in the corners of the building where you've got natural gas combustion right there, and then the blower blows it into the building. Or you've got hot water or even steam with radiator systems with highly distributed hot water or steam that's going through the heat exchanger, and then air blowing over this.

So, these are the types of things that we need now to electrify. Our options are, quite possibly, if you've got hot water, we really don't want to be working in steam. But if we've got hot water, we could be using electric boilers, but we could also be using heat pumps. So, right now, we are investigating heat pumps at multiple facilities a replacement for the types of systems. It turns out that hot water and steam systems, since you already have distribution, is actually easier to do than the ones that hang in the corner where you probably have to go to an electric version. Next slide.

And when we get to, you know, what do we use natural gas for, for processes, I mean, specifically, it is for parts washing and for cure. So, temperature cure. But our temperatures tend to be, I'd say, only medium heat requirements, and quite often, we're using an ambient cure, and the parts washers tend to be on a smaller size compared to, say, automotive, or appliances, where they're very large, right?

So, we do have natural gas that we use in our cleaning operations at the temperatures that we're using conversion to electric. It's just a matter of how much money and change, and that's the big thing, it also could be a major change to your manufacturing facility.

So, that is the emphasis on—you know, luckily, our processes don't have any really high temperature natural gas requirements. We do have aluminum casting, but all those right now are electric. So, thankfully, I don't have to add that to the roadmap, that was already done.

So, yeah. So, that is, that's a summary of what electrification looks like for us within our own greenhouse gas roadmap for Ingersoll Rand. And I'll just say, you know, working on this stuff, this is best done as a team sport, right? The teams we have working in the sites on this, they're really excited to be working on it and they come up with all kinds of good idea. So, thank you.

Kiran Thirumaran: Yeah, thank you, Gordon. Our next speaker is Antony Oaks. Antony has been at DENSO for 20 years. He started as a machine design engineer in 2002, eventually being promoted to managing, to be the manager leading that department in 2014. In 2019, he was asked to lead a group that was more focused on difficulty to automate processes and logistical automation. In April of 2022, Antony joined the newly formed Carbon Neutral Team. He is 100 percent allocated to carbon neutral in DENSO North America, with a focus on energy conservation, elimination of natural gas, and supporting the procurement of renewable energy.

Now, we'll hear from Antony.

Antony Oaks: Alright, thanks. So, I'm Antony Oaks, and I'm gonna share a little bit today about our electrification journey at DENSO. So, next page.

I won't read through this, but this is the agenda for this presentation today. Next page. One more.

So, first, a little background about DENSO. So, our global headquarters is in Korea and Japan. It's about 15 miles from Nagoya. Global sales, about 45,000,000,000 U.S. dollars, and then about just under 168,000 associates worldwide, in about 200 locations across the global network in DENSO. Next page.

In North America, this is what we look like in North America. So, we're about 50 sites, global sales in the $10,000,000,000.00 range, and associates, just under 24,000 associates in North America. Next page.

So, for DENSO, our committed goal is to be carbon neutral in scope 1 and 2 emissions by 2035. In North America, our upper

management has challenged us to accelerate this to 2030. So, we're investigating how we can pull this up. And this goal is without using carbon offset credits. So, it's a true carbon neutral.

Green, for us, has three different areas. The first is in manufacturing, so, to be carbon neutral at our plants. This is my area of focus with energy conservation, renewable energy, and electrification. Next, from the product side, we're developing products to support electrification of vehicles in the EHV and EV markets. And then third, develop systems that directly support carbon capture and other carbon neutral systems. Our headquarters has actually developed a carbon neutral—or sorry, a carbon capture process, and it is installed and prototyped at our plant in Anjo, Japan. And there's actually a YouTube on that if you're interested about that process. Next page. One more.

So, for CO2, this is what we look like in North America. Our emissions come from two main sources—natural gas and electricity, probably like most of us here. Natural gas is about 19 percent of our emissions, and this is measuring data at our 10 largest manufacturing sites in North America. For electricity, we have plans to purchase renewable to cover this amount of CO2. So, we've currently go on-site planned at five of our facilities. We're talking about green tariffs with the individual utility companies, and then we'll probably do a VPPA to cover the balance of those emissions. And all of this, we're planning to do by 2026. So, we should be carbon neutral for electricity end of '25, beginning of '26.

Then, for natural gas, we're trying to eliminate that from our process. On the right is the categories of where we use natural gas. So, first one, die cast—so, that's for melting aluminum. The rest of the presentation's about that, so, I'll explain that more later. Building heating—of course, there's a lot of, as Kiran said, there's a lot of activity in developing industrial scale heat pumps. For here, I think the biggest one is gonna be—the biggest struggle point for us is gonna be cost in this area. It's gonna be pretty expensive to replace all the existing gas air handlers.

Next category is brazing and VOC incineration. So, we have a lot of furnaces that cure products and also generate VOCs during that process. So, we have to incinerate those in the exhaust before we vent them to the atmosphere. So, eliminating this will probably be a combination of hydrogen fuel, electrification, and product design by trying to go to materials that don't emit VOCs in the curing process.

For the kiln, we have one ceramic product that requires a kiln. This one's very high temperature, so, we don't know exactly how we're gonna solve this one, but we're discussing electrification, hydrogen, and even carbon capture for this one. The coating group is mostly steam boilers, so, converting those from natural gas to electric is not that difficult. And then miscellaneous is mainly like food prep. So, most of our plants have cafeterias in them. So, this also is not so difficult to convert those to electric. Next page. One more.

So, our examples are in die casting. So, this is kind of an overview of our die casting process. So, we receive solid ingots from our supplier. Those are loaded into a central melt furnace. We have a series of natural gas burners that apply heat to the aluminum and then it melts and flows into a holding furnace. We have additional burners that keep that from turning back solid. Then, as needed, we have a forklift which has a ladle on it, and it will come to the central melt furnace, and we can unload the holding furnace into the ladle, and then that fork truck will drive to the individual die cast machines and pour the aluminum in the holding furnace. And then there's additional gas burners here that would keep the aluminum liquid until it's consumed by the die caster. Alright, next page.

So, the examples we have, we have two areas that we have to electrify. Basically, the first slide is gonna be a slide about the holding furnace, what we've done there, and then the second one is gonna be our future plans with the central melt furnace. Next page.

So, our original design for the holding furnace, this probably dates back into the early 2000 range was, we had, basically, just more natural gas burners that heated the surface of the aluminum to keep it solid. It was a pretty effective heating method, and pretty good heat transfer. And at the time, it was a very inexpensive fuel source. But, you know, as we progressed over the next decade, that became more costly.

So, we set the piece part cost, part cost index, and the running cost both at 100 percent to kind of benchmark a change to electrification. The first revision of our heaters was the global style. So, basically, what that did is just replace the burner with an electric heater. It still heated the surface of the aluminum, so, you still lost a lot to the environment, because it wasn't completely transferred to the aluminum.

If you look down toward the bottom—so, it does have a lower running cost, but if you tried to justify throwing the original furnace away and replacing it with this first revision, it actually made the part cost more expensive for the product. So, our strategy for this one became, as we built new die cast cells, we would use the globar style furnace, but we would keep the gas burning on the existing die cast machines as we increased our manufacturing.

Then, probably about five—maybe five years ago, we tried this immersion style furnace. So, this one's unique because the heater is actually in the metal instead of on the surface. So, really good heat transfer, because the heat doesn't really have anywhere to go except into the metal. So, you can see from the running cost there, very low compared to the other two. But also, this one has the benefit is, if you're trying to replace the natural gas burning style, even with the investment of this system, it ends up making the part cost less. So, as we go forward, we have one of these now, so, as we go forward, this will become the standard design for our whole new furnace. Alright, next page.

Alright, and finally, there's not a lot of material here, because we're just now kind of starting that investigation, but of course, we have to eliminate natural gas and the melting furnace. So, really, that's kind of evolving into three separate choices or three potential choices for us. So, one, we're considering replacing this entire system with a big induction furnace, electrical induction furnace. The second one is, we're considering just replacing the fuel. So, modifying this to use hydrogen instead of natural gas. And then the third option is probably what we'll end up doing, what we're leaning toward right now is, eliminate the central metal furnace altogether and develop a small holding melting furnace at each individual die cast.

So, for the hydrogen fuel, our global headquarters in Japan has already completed a prototype for this, actually using hydrogen instead of natural gas. And then for this year, we have it in our budget to do a prototype induction, small induction furnace. So, at the completion of that, we'll have both of these options set and we'll have data for those, so each group can kind of make their own decision about what, which way makes the most sense, region by region. Alright, next page.

And then finally, just final comments. So, at DENSO, we're committed to protecting the environment by achieving carbon neutral status by 2035. And the next page. And that's basically it for that presentation. So, thanks for your time.

Kiran Thirumaran: Yeah, thank you, Antony, for the wonderful presentation. A quick reminder to our audience to send in any questions you have at Slido.com, with the event code #DOE. We look forward to answering your questions at the end of the webinar.

So, our next speaker is Nickyle Milton. Nickyle is joining us from Siemens. He is an Engineering Program Manager and Lead Manufacturing Expert with Siemens Smart Infrastructure Electrical Products, supporting the manufacturing of low voltage switchgears and switchboards. He has a proven track record to justify scope and execute multimillion dollar capital projects that have introduced new technology and robotics to the frontline operations. Nick holds a Bachelor's degree in Electrical Engineering from Louisiana State University with a minor in Computer Science.

Nick, take it away.

Nickyle Milton: Alright, good morning, guys. My name is Nickyle Milton, Engineering Program Manager at Siemens, and today, I'll be presenting decarbonization of our manufacturing facility here in Grand Prairie, Texas. Next slide.

So, here are the topics that we're gonna review today. First, we'll dive into Siemens Global Sustainability framework. We'll then have a quick overview of Siemens EP North American portfolio. Next, we'll discuss the decarbonization efforts at our pilot plant in Grand Prairie, Texas. And in conclusion, we'll review what's next for our remaining facilities. Next slide, please.

So, here you see a comprehensive breakdown of Siemens' views on sustainability are the green frameworks that set clear priorities for sustainability at Siemens through decarbonization, ethics, governance, resource efficiency, equity, and employability. Today's presentation will narrow in on our efforts to decarbonize. Next slide.

So, Siemens' commitment to our driving force in supporting the de carbonization programs, as we are focused on decarbonization, we'll see our commitments align at Siemens Operation Net Zero by 2030 with frameworks and action fields that include clean power sourcing, on-site generation, and efficiency measures. Next slide.

So, how do we maximize decarbonization in our footprint? So, here, we see an overview of our North American operation and

electrical products. We have nine total factories with over 1.5 million square feet of manufacturing space. We produce 480 volt switchgears, switchboards, and circuit breakers, just to name a few. Through assessment of our operations, we have learned that our eight powder coat paint lines produce 70 percent of the CO2 emitted from our factories. HVAC also makes up a large portion of the remaining 30 percent of CO2 emitted. So, we utilized the data from the assessments to begin working towards the strategy and a solution for the total enterprise, starting with our Grand Prairie, Texas facility. Next slide, please.

So, here, we see a total energy consumption breakdown of our Grand Prairie facility. There's an approximately 50/50 split between gas and electricity consumption. We currently source renewable energy credits for 100 percent of the electricity consumed within the facility, which brings our locations based emissions down 60 percent from 4,300 to 1,700 metric tons of CO2 emitted. So, this leaves the facility with the remaining 40 percent of net carbon emission from natural gas to be eliminated. Next slide, please.

So, this slide shows a more detailed breakdown of the main energy consumers here in Grand Prairie. With this data, we see our paint process and HVAC make up about 90 percent of the energy consumed by natural gas, validating the statement made in a previous slide. Next slide, please.

So, the data on the previous slide was then used to determine solutions and priority, with the powder coating line being the largest carbon emitter, our number one priority is to electrify our paint process, followed by 100 percent HVAC electrification and lighting efficiency efforts. Once those two actions are complete, we'll assess the operation and focus on what we expect to be a high number of actions with small incremental impact to our carbon footprint. Next slide, please.

Alright, so, let's dive into our efforts to electrify our powder coating line. You see here a typical layout for powder coating paint—you load the part on an overhead conveyor, it then goes through a five-stage pre-treatment cleaning. Next, it enters a 250-degree dry-off oven to remove moisture. The part then gets powder applied to its surface. Finally, enters a 400-degree curing oven where, after, it's unloaded to be assembled onto our gear.

So, I'd like to focus on the stages of the process where we see heating, the pre-treatment, 250-degree dry-off, and 400-degree

curing oven are all heated by natural gas. Next week, we're breaking ground on a 23,000-square foot expansion to house a brand new, all-electric powder coating line. We understand this to be the first system at this scale in the U.S. One thing to note, this system is energy extensive, requiring 7,000 amps of current at 480 volts. In parallel, we've begun working with our paint vendors to reduce this requirement. We have a low heat powder in development to reduce the 400-degree curing requirement by 20 percent to help reduce consumption. Next slide, please.

So, the next focus area has been HVAC and lighting. We'll reduce electrical cooling consumption by installing IceCOLD catalysts and Climatix building control. We'll also be electrifying the heating element of the facility by eliminating natural gas RTUs. Next slide, please.

So, following the completion of these actions, we estimate that electricity will make up about 95 percent of the total energy consumed on-site, with the remaining 5 percent of natural gas consumption coming from natural gas hot water heaters and propane forklifts. Next slide.

So, taking a deeper dive into the data, we expect our electricity usage to double to 14,000 megawatt hours from roughly 7,000 megawatt hours currently. In the future, we plan to install an 1,800-megawatt hour solar array on-site, to offset that increase a bit. We also expect to see our natural gas usage reduced to 90 percent, and the CO2 emitted from the facility to fall 93 percent. As mentioned before, the remaining CO2 emitted, we expect to be from natural gas, hot water heaters, and propane forklifts. Next slide, please.

So, in conclusion, Grand Prairie is just the beginning. We also will be applying the concepts learned at Grand Prairie at other brownfield sites to electrify. We understand that the transition to electrification is the first step in our journey. We'll continue to drive sustainability enhancements through the business by engagement with R&D, academia, government officials to have access to the latest technologies to reduce electrical consumption and generate energy on-site in a cost-effective manner for the business.

Also, we're currently on track to begin construction on a new LEED Gold greenfield factory in Pomona that will also be home to an all new electric painting system.

I'd like to thank the Department of Energy and the Better Buildings platform for having me. Thanks, guys.

Kiran Thirumaran: Yeah, thank you, Nickyle, and to all our panelists for your insightful presentations.

So, before we transition to the question and answers, I want to encourage you to download our Additional Resources handout. It is shared in the Resume Chat box. The handout contains links to resources from the Better Buildings program and our speakers on the topics today. So, we hope you find that helpful. Okay.

So, now, to move on to the question and answers. If you haven't already, please join us on the Slido.com with the event code #DOE to submit and upload the questions. Okay. So, yeah, we will move to the questions and answers.

So, one of the most up voted questions we have here is, the question I get the most is how we are going to provide the extra electricity without stressing the grid, right? So, I do have a couple of points for that, but I do wanna turn it to our panelists first to see how they are addressing this issue on the grid, how are they sourcing the electricity. Because I think the follow up—there was a follow up question to that, as well which said how to handle a large load, like, say, a boiler or even like an induction furnace like DENSO is operating without significant electrical infrastructure upgrades.

Nickyle, Gordon, Antony, do you wanna take it?

Antony Oaks: Yeah, for us, in addition to the grid, we have a—basically, have a substation at most of our sites. And with our growth and the electrification, a lot of those are gonna have to be upgraded, as well. So, we've got some pretty long-term predictions from our Facilities Department about the upgrades we have to do for that.

But yeah, in general, just the overall individual utility grids, I mean—yeah, that's a good question. I don't—unfortunately, I don't have a lot of insight on that one, other than recognizing that it could be a potential problem. But inside the facility, we're doing a lot of long-term predictions of how much we're gonna have to upgrade our internal grids.

Nickyle Milton: Yeah, so, I think, what I've been seeing is that we'd really have to transition to generating our own energy off-site—on-site, sorry. What I've noticed is that in R&D pipelines, there is technology

that's coming up that currently hasn't been brought to commercial markets that is in place and in the pipeline, we just have to wait for it to hit the market. But we do believe that local generation on-site is necessary to not stress the grid. And I think there will be some development technologies in the coming years, in the next 7 to 10 years, that will help offset that and help the world with those things.

Gordon Smith: For us, we have just over 70 sites, so, it really becomes a very site specific analysis of whether, first off, do you have the internal capacity, transformers and capacity, and then of course, does the municipality or whoever you are connecting to, do they have the ability to even provide you, right?

But the second piece of it is, what's your opportunity to reduce your electrical load through efficiency, right? Do you currently need to use as much as you're using? So, if you've got a 5 percent increase in electrification caused by electrification, and you can get 10 percent up by additional efficiency, maybe you've got a pathway that way, too. But it really is an individual site analysis that has to be done.

Kiran Thirumaran: Yeah, thank you, all. I think that was a great question. And just to reiterate the point, right, that Nickyle mentioned, that one way is to have on-site and also, like, when you're going with electrification, there is going to be an efficiency improvement. So, the amount of energy that you need is going to be coming down.

A follow up question to this is—so, whenever we talk about electrification, this comes up, right, "What about the grid?" One aspect of that is the grid capacity that we spoke about. And another one is, what is the source of the energy coming from the grid, right? If you are burning fossil fuel at the front end to make the electricity, you are not gonna get the decarbonization benefits for electrification.

So, for both those questions, there is a lot of resources that are being spent within DoE and in the state and federal level to improve capacities, and also to make, like, the grid cleaner with time, right? So, if you look at any projection that is coming out of EPA or any of those organizations, you will see that—so, what the grid is gonna be in 2040 and 2050, the exact composition is up for a debate. But it is not gonna be the 20 percent renewable that they're gonna be seeing now, right? So, conservative estimate, we can see anywhere from like 50 to 80 percent of the grid is gonna be cleaner in the next 20, 25 years.

So, it is a parallel improvement. Like, the grid is gonna cleaner, and we can implement electrification in parallel to realize the benefits of decarbonization. Yep. Yeah, great question.

So, the next one we have—so, I think this is addressed to Gordon. "How will the recycling of battery packs be addressed to ensure they are disposed of properly?" So, this is related to the forklifts, Gordon.

Gordon Smith: Yeah, no, that's a very good question as we add more and more, what is often lead acid or maybe lithium batteries, what do we do with them at end of life? So, this is really tied to our much wider waste strategy, which involves identifying all our waste streams and chasing them all backwards and reducing them, but also finding that—making sure that we're actually putting them into a recycle loop that is legitimate, right? So, we're actively working on that right now as part of our larger waste reduction program.

Kiran Thirumaran: Yeah. Thank you, Gordon. So, the next question we have is related to demand response. "So, are our speakers' companies using demand flexibility strategies to reduce cost and grid stresses—time of use, demand shifting, energy storage, grid interactive equipment, et cetera, not just old fashioned curtailment?"

So, is any of your companies using anything more comprehensive than just the demand response curtailment? I think that is the question. Okay.

Antony Oaks: Our largest facility in North America uses a—we call it an ice house. I'm not sure what the technical term is. But we freeze water at night when the demand is low, and then we use that for air conditioning in the plant through the day. There's also some talk at some of the facilities, particularly Canada, that is very interested in adding battery storage to offset some of the costs that they see, due to the demand charges.

Kiran Thirumaran: Thanks, Antony. Nickyle, anything from your end? Because I know you mentioned you're building a new facility, right? So, I'm assuming there is a little bit more flexibility in how you could approach some of these things in a new construction? Are you thinking about demand control—demand response strategies?

Nickyle Milton: I believe we are. So, I'm located in Texas and California and they're significantly different, you know, in terms of demand. Energy is a lot cheaper here in Texas. So, in California, currently,

we're gonna add solar panels to the building. I believe we are looking at battery storage on-site in addition to, potentially, a greenfield site somewhere off-site and having it support that site. So, we are looking at demand curtailing, it's just, I believe the strategy is still being worked on at this point in time.

Kiran Thirumaran: Yep. Thanks, Nickyle.

Gordon Smith: Yeah, we really don't have any kind of system sitting on top of it, but what Nickyle just said is the same. So, we're adding, specifically in Europe, where you've got a very high price of energy, we're looking at a lot of before the meter type solar, and now, we're pushing into exploring batteries to try to get that capture at the same time. So, that's, like, our big effort right now.

Kiran Thirumaran: Thank you, Gordon. So, the next question is, "Converting steam boilers to electric can be difficult when the spike in kilowatt at the facility transformers have to be upgraded. How do you overcome increased electric infrastructure requirement?" Right? So, this is very similar to the question we answered, we took first.

So, yes, so, we do need, in cases where you're putting in an excess of electric capacity and your infrastructure doesn't—your facility level infrastructure or your utility site infrastructure doesn't support it, you would need an upgrade, either at the substation level, or within your switchgears in your facilities, right? So, you would be needing to do that when you're looking at—when you don't have the necessary equipment.

So, the next one is, "When considering heat pumps for building space heating"—yeah, is there any other additional thoughts on the boiler one from any of the speakers? I know we did talk about the infrastructure a little bit. Okay.

Alright, so, we can move onto the next one. "So, when considering heat pumps for building space heating, are you looking, primarily looking into air source or ground source?" So, I know, Gordon, you're looking at heat pumps. I know—

Gordon Smith: Yeah, I mean, heat pumps are always better. You need a source of heat, right? So, I mean, if we've got a source of heat that's coming from, say, testing of—continuous testing of compressors, that could be used as a heat pump for another process that requires it, or even some of the building heat. It could also be that, if we don't have those things, we need to go looking at whether we've got the air transfer, or whether we need to go to water. So, really, at this

point, we're exploring whatever sources of heat are available at the site level.

Kiran Thirumaran: Mm-hmm. So, primarily, you're looking at waste heat options, Gordon, before looking at, say, something like a ground source as the source, right?

Gordon Smith: We don't have a lot of waste heat options, because they need to be continuous. If you're gonna count on it for building heat, it needs to be always there when you need to heat the building, right, which is pretty much 24/7 in the winter. So, the only time we have that is when we're continuously testing compressors at some facilities. But I don't know that we're gonna find it, honestly. I think it's gonna be air or possibly water, yeah.

Kiran Thirumaran: Alright. Any other inputs from our other panelists? Alright, so if not, I think we'll move to the next question. "Can DoE showcase deep decarbonization strategies for steel and cement industries?" Okay, so, I think I will take that.

So, I'm not exactly sure what you mean by showcase, but DoE has put out a lot of, like, resources and, like, roadmaps for deep decarbonization strategies by specific industries, right? So, you can either look it up, it's called, *The Decarbonization Roadmap*, put out by DoE, and it is sector specific decarbonization roadmaps. It goes through different strategies that industries—specific sectors could take a look at for achieving their decarbonization goals. If you're not able to find it, please e-mail and I can point you to the right resources. Alright.

So, the next question is, "It seems like facilities will be updated to electrified solutions at end of life or when new capacity is needed. Is there any chance of this being accelerated, such a through government incentives?" Right? So, that's a great question.

So, definitely, from the DoE side, there has been a lot of the infrastructure, bipartisan infrastructure law that has been passed that provides a lot of resources and incentives for decarbonization solutions. Utility rebates are available, depending on your region. So, there is a lot of incentives, definitely, out there, and also tax credits from the federal side, as well, that is available for electrifications, right? That is, essentially, all of those are set in place to accelerate this change.

Any specific things that you have made use of in your facilities that you wanted to talk about?

Gordon Smith: I can talk a little bit. So, at the utility level, there's several states that offer some really nice incentives for doing some of these things that I've taken advantage of in the past. These things tend to come and go, so, you gotta act on it fast.

Also, you know, if we go outside of the U.S., Australia had a program a couple years ago where they just offered a significant amount of rebates for doing solar on-site, and we put in a massive solar system as a result, and then it disappeared. The same way for Italy. You know, for a while there, a couple years, there were really nice incentives on on-site solar, and then they disappeared. So, we try to really keep an eye on this and be smart enough to jump on it if an opportunity presents itself.

Kiran Thirumaran: Okay, alright. Anyone else? Alrighty. So, I think we'll take a few questions, maybe a chronic pain questions more. "Does your facility use on-site solar to help avoid demand charges from your utility?" I think we spoke about demand response a little bit. Is there anything you wanna add to that on using solar to achieve it?

Gordon Smith: I certainly can, and we've got quite a few solar now, so, it's quite possible that that is also having the impact, but that was not our initial driving reason for it. But it certainly can, depending on the utility circumstance.

Kiran Thirumaran: Okay.

Nickyle Milton: And I think for us, when it makes business sense—for example, the facility and the system we're implementing in Grand Prairie, Texas, right, in the future, we'll offset it with solar, some of those demand charges with solar, you know, as it becomes financially incentivized. But the price of a kilowatt hour in California is significantly different from Texas. So, there are significant savings in the California system. So, solar—a large solar field is being put in for California, for the California system. So, that is in the plan.

Kiran Thirumaran: Alright, thanks, Nickyle.

Antony Oaks: Yeah, I think DENSO is basically the same a Gordon. So, it may show some benefits, but it wasn't really a factor in going for on-site solar at our locations.

Kiran Thirumaran: Okay. Yeah. Thank you, Antony. So, I'm scrolling through my Slido questions to see if there is any specific quick questions that we could take. So, yeah, I have one for Siemens. "Siemens, what is

the technology you're using for electrifying the paint lines?" Is it, I think the question is, *[Cross talk]*.

Nickyle Milton: So, in the pre-treatment system, we're using immersive electric heat exchangers in the pre-treatment system. The ovens are typical electric blower pumps. Following the paint application, there'll be like a, I believe it's a seven or eight-minute infrared curing boost, right? And then the curing oven, it's also just standard electric heating blowers. And like I said, the current curing oven, that's where the bulk of the energy comes from, that and the pre-treatment system.

One thing we have done, it's a six-stage pre-treatment system, and there's currently two heated stages. In the new system, one of those heated stages will go to ambient, so, that's—we reduced our consumption there. Also, in the curing oven, once the powder is applied, like I said, we have a powder in development that will reduce that energy requirement. We're shooting for 325, but it's looking like it's gonna be in the 350-degree range ballpark.

So, I think it's a combination of things, the chemistry and the pre-treatment, you know, driving our vendors to make that application ambient temperature. And also, in the curing phase, driving our paint vendors and the R&D Department to make that requirement as low as possible. And what we're seeing is, we're now on the brink—I think we're one of the first customers to go, I wouldn't say one of the first, but we're one of the beginning customers to ask them to do that and making that requirement on them.

So, I think it's, as we progress with time and technology catches up, I think we will see solutions that make financial benefit for different companies.

Kiran Thirumaran: Yeah. Thank you, Nickyle. And thank you, everyone, for your questions, and to our panelists for their insightful responses. So, this webinar was our final installment of the 2022-'23 Better Buildings Webinar Series. So, all the webinars that we have done from the series are available to watch on demand on the Better Buildings Solution Center. We look forward to seeing you during our summer series as well as during our 2023-2024 webinar series, the topics for which will be announced soon.

So, next, we are pleased to announce the registration for the 2023 Better Buildings Better Plants Summit is now open. The summit will be held in the heart of the D.C. area, Washington, D.C. area April 11th through the 23rd. So, in addition to having engaging

and interactive sessions, you can look forward to networking with your fellow industry peers and experts. So, you can explore the session tracks and book your accommodation on the Better Buildings Solution Center website.

So, with that, I would like to thank our panelists for taking the time with us today. So, feel free to contact our presenters directly with additional questions or, if we couldn't get to your question during the Q&A period, definitely reach out to us. I encourage you to follow the Better Buildings Initiative on LinkedIn and on Twitter for all the latest news. You can find their handles by their respective icons on the left half of the slide that you see. You will receive an e-mail notice when today's recording, slides, and the transcripts are available on the Better Buildings Solution Center.

Thank you, everyone.

[End of Audio]

It's Electric! Electrified Alternatives to Industrial Fossil Fuel Systems

Additional Resources

Learn more about the topics discussed on the webinar by visiting the resources below.

Better Buildings Resources

- Learn more about the MEASUR energy modeling tool
- View the DENSO partner profile
- View the Siemens partner profile
- View the Ingersoll Rand partner profile

Explore more resources on the Better Buildings Solution Center

Other Resources

- Learn about the history of Ingersoll Rand
- Read this article on DENSO's industrial electrification efforts
- Explore Siemen's eMobility® Solutions
- The 2018 EIA Manufacturing Energy Consumption Survey Consumption Results

The 2022-2023 Better Buildings Webinar Series

This webinar was our final installment of the 2022-2023 Better Buildings Webinar Series. We hope you will join us for our 2023 Summer Webinar Series. Webinar topics will be announced soon!

Follow Better Buildings on Twitter and LinkedIn

@BetterBldgsDOE

company/better-buildings